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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/657,894	09/09/2003	Hieronymus Andriessen	224088	2642

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EXAMINER	
BARTON, JEFFREY THOMAS	
ART UNIT	**PAPER NUMBER**
1753	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/01/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/657,894	ANDRIESSEN ET AL.	
	Examiner	Art Unit	
	Jeffrey T. Barton	1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 December 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *20030909*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Graetzel et al (EP 1 176 646 A1) in view of Van der Auweraer et al (J. Phys. Chem. 1993, 97, 8808-8811). Supporting evidence is provided by Thelakkat. (Macromol. Mater. Eng. 2002, 287, 442-461)

Regarding claims 1 and 8, Graetzel et al disclose a photovoltaic device (Figures 1 and 2) comprising an n-type semiconductor with a bandgap over 2.9 eV (Titanium dioxide particles 6; Page 3, line 58 - Page 4, line 1), and an amorphous reversibly oxidizable hole-transporting organic material. (Page 2, lines 39-44)

Regarding claims 3 and 10, Graetzel et al disclose using several of these semiconductors. (Page 2, lines 36-38)

Regarding claims 4-6 and 11-13, Graetzel et al disclose quantum dot spectral sensitizers (Figure 2, q-dots 7), which are disclosed as nanoparticles of metal chalcogenides, such as PbS or HgSe/CdSe. (Page 3, lines 6-8 and 19-22)

Regarding claims 7 and 14, Graetzel et al disclose methods of making their photovoltaic cells, comprising providing a support with a conductive layer as an electrode (Tin oxide-coated glass; Page 4, line 5), coating the conductive layer on the support with the n-type semiconductor (Page 4, lines 5-8), coating the n-type semiconductor with a solution of the hole transport material that is subsequently dried (Page 4, lines 14-17), and applying a conductive layer to the hole transport material layer to provide a second electrode. (Page 4, lines 18-19)

Graetzel et al does not disclose hole-transport compounds as claimed in instant claims 1, 2, 7, 8, 9, and 14.

Van der Auweraer et al teach the hole transport abilities of amorphous layers of 5'-[4-[Bis-(4-ethylphenyl)amino]phenyl]-N,N,N',N'-tetrakis-(4-ethylphenyl)-1,1':3',1"-terphenyl-4',4"-diamine, which corresponds to the structure given in claims 1, 7, 8, and 14, and the first listed compound in claims 2 and 9. This compound is shown to have comparable or superior hole mobility to other known hole transport materials. (Table I)

It would have been obvious to one having ordinary skill in the art to modify the devices and methods of Graetzel et al by replacing their hole transport material with the compound taught by Van der Auweraer et al, because Van de Auweraer et al teach its comparable or superior hole mobility to other known hole transport materials. The selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding the limitation to the compound being in "cationic form" in claims 1-7, the presence of a hole in this hole transport material inherently imparts a positive charge to the molecule, since the hole is the absence of an electron. Van der Auweraer speaks of a "one electron oxidation-reduction process" (Introduction, 1st paragraph) associated with hole or electron transport, and a more thorough description of hole transport in triarylamine compounds is given by Thelakkat. (Pages 443-444,

"Triarylamine as Functional Moiety" section) This section of Thelakkat describes the triarylamine unit's "ability to transport positive charge centers via the radical cation species". Since hole transport in triarylamine compounds is clearly associated with a cyclic oxidation/reduction process involving a cationic radical species, it is the examiner's position that the cationic form of the hole transport material taught by Van der Auweraer will inherently be present in the device taught by this combination.

5. Claims 1, 3-8, and 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Graetzel et al (EP 1 176 646 A1) in view of Shirota. (J. Mater. Chem., 2000, 10, 1-25) Supporting evidence is provided by Thelakkat. (Macromol. Mater. Eng. 2002, 287, 442-461)

Regarding claims 1 and 8, Graetzel et al disclose a photovoltaic device (Figures 1 and 2) comprising an n-type semiconductor with a bandgap over 2.9 eV (Titanium dioxide particles 6; Page 3, line 58 - Page 4, line 1), and an amorphous reversibly oxidizable hole-transporting organic material. (Page 2, lines 39-44)

Regarding claims 3 and 10, Graetzel et al disclose using several of these semiconductors. (Page 2, lines 36-38)

Regarding claims 4-6 and 11-13, Graetzel et al disclose quantum dot spectral sensitizers (Figure 2, q-dots 7), which are disclosed as nanoparticles of metal chalcogenides, such as PbS or HgSe/CdSe. (Page 3, lines 6-8 and 19-22)

Regarding claims 7 and 14, Graetzel et al disclose methods of making their photovoltaic cells, comprising providing a support with a conductive layer as an

electrode (Tin oxide-coated glass; Page 4, line 5), coating the conductive layer on the support with the n-type semiconductor (Page 4, lines 5-8), coating the n-type semiconductor with a solution of the hole transport material that is subsequently dried (Page 4, lines 14-17), and applying a conductive layer to the hole transport material layer to provide a second electrode. (Page 4, lines 18-19)

Graetzel et al does not disclose hole-transport compounds as claimed in instant claims 1, 7, 8, and 14.

Shirota teaches the hole transport abilities of amorphous TDAPB and *o*-, *m*-, and *p*-MTDAPB, which correspond to the structure given in claims 1, 7, 8, and 14. (Structures on page 4, partial mobility data in Table 3) This compound is shown to have comparable hole mobility to other known hole transport materials. (Table 3) In addition, Shirota teaches the usefulness of these organic hole transport materials in photovoltaic cells, including photoelectrochemical cells, such as those taught by Graetzel. (Introduction, Organic photovoltaic devices sections)

It would have been obvious to one having ordinary skill in the art to modify the devices and methods of Graetzel et al by replacing their hole transport material with TDAPB, *o*-, *m*-, or *p*-MTDAPB as taught by Shirota, because Shirota teach its effectiveness in hole transport and suggests the usefulness of this class of compounds in providing hole transport in photoelectrochemical cells. (Introduction, Organic

photovoltaic devices sections) The selection of a known material based on its suitability for its intended use supports a prima facie obviousness determination. See *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945).

Regarding the limitation to the compound being in "cationic form" in claims 1 and 3-7, the presence of a hole in this hole transport material inherently imparts a positive charge to the molecule, since the hole is the absence of an electron. A description of hole transport in triarylamine compounds is given by Thelakkat. (Pages 443-444, "Triarylamine as Functional Moiety" section) This section of Thelakkat describes the triarylamine unit's "ability to transport positive charge centers via the radical cation species". Since hole transport in triarylamine compounds is associated with a cyclic oxidation/reduction process involving a cationic radical species, it is the examiner's position that the cationic form of the hole transport material taught by Shirota will inherently be present in the device taught by this combination.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dr. Jeffrey T. Barton whose telephone number is (571) 272-1307. The examiner can normally be reached on M-F 9:00AM - 5:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nam Nguyen can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

JTB
29 January 2007

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